Geologic Resource Evaluation Scoping Summary
San Antonio Missions National Historical Park, Texas

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The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park System units with a geologic scoping meeting and summary (this document), a digital geologic map, and a geologic resource evaluation report. The purpose of scoping is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and monitoring and research needs. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity to discuss park-specific geologic management issues, and if possible include a site visit with local experts.

On April 22, 2008, the National Park Service held a GRE scoping meeting for San Antonio Missions National Historical Park at the headquarters building on Roosevelt Avenue, San Antonio, Texas. Chief of Interpretation and Acting Superintendent Al Remey welcomed the group and presented some background information about the park. Andrea Croskrey (Geologic Resources Division) facilitated the assessment of map coverage, and Bruce Heise (Geologic Resources Division) led the discussion regarding geologic processes and features.

Participants at the meeting included NPS staff from the park, Gulf Coast Network, and Geologic Resources Division, and cooperators from the Texas Bureau of Economic Geology, U.S. Geological Survey, and Colorado State University (table 2). As part of scoping the group participated in a field trip to local outcrops, the aqueduct, missions (including the sinkhole site at Mission Concepción), and the San Antonio River near Mission San Juan, where participants could readily compare a stretch of the natural channel with a highly modified reach.

Park and Geologic Setting

Authorized November 10, 1978, and established April 1, 1983, San Antonio Missions National Historical Park covers 331 ha (819 ac) that stretch along the San Antonio River. Four missions—Mission Nuestra Señora de la Purísima Concepción de Acuña (Mission Concepción), Mission San José y San Miguel de Aguayo (Mission San José), Mission San Juan Capistrano (Mission San Juan), and Mission San Francisco de la Espada (Mission Espada)—and associated structures comprise the national historical park. During Spanish colonization, each mission had land for farming and ranching. Mission Espada’s grazing lands is known as Rancho de las Cabras, the “Goat Ranch,” a portion of which is part of the national historical park. Not far from Espada, a Spanish colonial dam and aqueduct still divert water from the San Antonio River. Near Mission San Juan, original *labores* (agricultural fields) and *acequia* (irrigation ditch) are part of the Mission San Juan Spanish Colonial Demonstration Farm. The first mission on the San Antonio River (founded in 1718) was Mission San Antonio de Valero, commonly called the Alamo. Now a state historic site, the Alamo has been under the care of the Daughters of the Republic of Texas since 1905; it serves as a shrine to Texas state patriotism.

These five missions, a presidio (fort), and settlement were the seeds for a successful Spanish community and helped form the foundation for the City of San Antonio. Representing an almost unbroken connection with the past, the missions flourished between 1747 and 1775 and remain active parishes today. The National Park Service has cooperative agreements with the Archdiocese of San Antonio, City of San Antonio, County of Bexar, State of Texas, and the San Antonio Conservation Society for managing and protecting the missions.

The headwaters of the San Antonio River, springs, and forests with abundant wildlife and vegetal resources for foraging and hunting attracted both prehistoric and historic peoples (Osburn et al. 2007). The archaeological sites associated with the missions reflect occupations ranging from possible Paleo-Indian through Spanish colonial periods (Texas Historical Commission 2007). Urbanization has overtaken and segmented the areas surrounding the missions; nonetheless, the cultural landscapes and the total areas within the National Park System boundaries are part of the National Register nomination (National Park Service 1982). Furthermore, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) is considering San Antonio Missions National Historical Park for designation as a world heritage site. The UNESCO World Heritage List recognizes the most significant cultural and natural treasures on the planet.

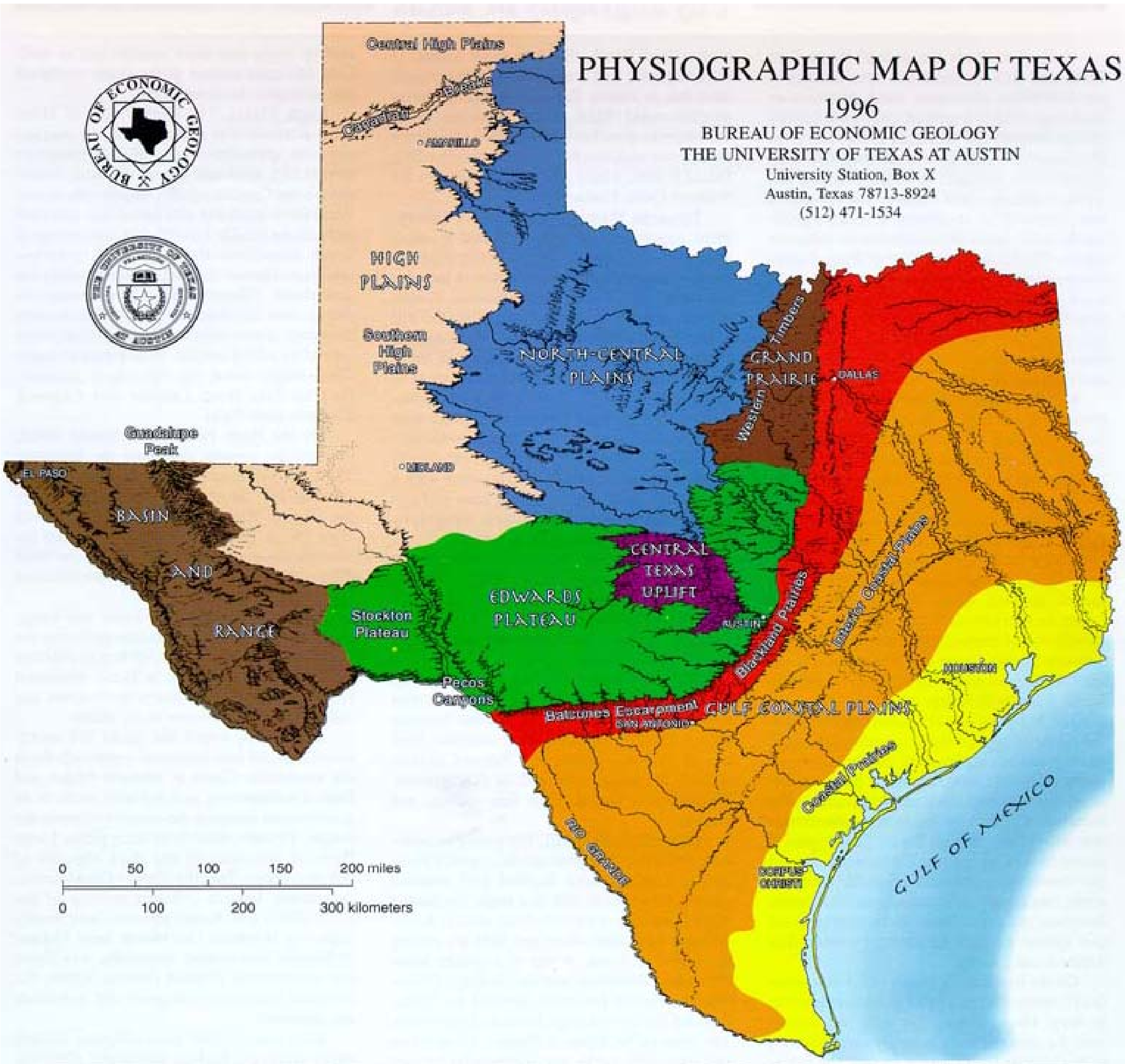

Figure 1. Physiographic Provinces of Texas. San Antonio Mission National Historic Park is located on the southeastern edge of the Balcones Escarpment.

San Antonio Missions National Historical Park is located in southern Bexar and Wilson Counties, Texas, along a roughly 19-km- (12-mi-) stretch of the San Antonio River near the southeastern edge of the Balcones Escarpment (Osburn et al. 2007). The Balcones Escarpment—a broad area of faulted limestone that forms the southern and eastern edge of the Edwards Plateau—primarily governs the regional physiography (fig. 1). The Edwards Plateau—a rugged hilly region dissected by many small streams, lies to the northwest of the escarpment (Osburn et al. 2007). Geologic units exposed in and near the San Antonio area include the

Cretaceous Navarro and Taylor groups, the Paleocene Wilcox and Midway groups, and large deposits of Quaternary sediments (Barnes 1992). These rocks are composed of chalk, limestone, sand, and mud (Walker and Coleman 1987; Wermund 1996). Scoping participants noted the Wilcox sandstone that crops out near the aqueduct and the tufa quarry (Quaternary) near Mission Concepción.

According to Osburn and others (2007), slope processes, bedrock lithology, and stream incision along the margins of the Edwards Plateau (i.e., Balcones Escarpment) impact the genesis and geomorphic history of landforms in settings immediately below the plateau. Geomorphic landforms in the area include the stabilized channel and narrow floodplain of the San Antonio River; abandoned channels; a number of San Antonio River terraces; stabilized banks; and portions of adjacent, low-relief uplands (Osburn et al. 2007).

Mapping Plan for San Antonio Missions National Historical Park

During the scoping meeting, Andrea Croskrey (Geologic Resources Division) showed some of the main features of the GRE Program's digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of being GIS compatible. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation for the GRE Program and allows for rigorous quality control. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcGIS software. Final digital geologic map products include data in geodatabase and shapefile format, layer files complete with feature symbology, FGDC-compliant metadata, a Windows HelpFile that captures ancillary map data, and a map document that displays the map and provides a tool to directly access the HelpFile. Final products are posted at http://science.nature.nps.gov/nrdata/. The data model is available at http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm.

When possible, the GRE Program provides large-scale (1:24,000) digital geologic map coverage for each park's area of interest, which is often composed of the 7.5-minute quadrangles that contain parklands (fig. 2). Maps of this scale (and larger) are useful to resource managers because they capture most geologic features of interest and are spatially accurate within 12 m (40 ft). The process of selecting maps for management begins with the identification of existing geologic maps in the vicinity of the park (table 1). Scoping session participants then discuss mapping needs and select appropriate source maps for the digital geologic data or, if necessary, develop a plan to obtain new mapping.

Park staff identified the following 7.5-minute USGS quadrangles as the area of interest: San Antonio West, San Antonio East, Terrell Wells, Southton, Elmendorf, Losoya, Saspamco, Floresville, and Dewees (fig. 2). A number of regional geologic maps cover this area: the 1:100,000 USGS statewide GIS shapefile (GMAP 74114), the 1:125,000-scale groundwater geology maps of Bexar County (GMAP 27997) and Wilson County (GMAP 74964), the 1:250,000-scale *Geologic Atlas of Texas* (GAT) San Antonio sheet (GMAP 2879), and the 1:250,000-scale structure map of the Edwards Aquifer (GMAP 42707).

Upon inspection, GRE staff found little correlation between the contacts drawn on the county geology maps (GMAP 27997 and 74964) and the statewide GIS (GMAP 74114) (see fig. 3). This is probably a result of the Bexar County map not including any surficial mapping. Because the Bexar County map does not have surficial units, it appears to have more faults, perhaps explaining the absence of some faults (bright red lines) in the GIS data. The geologic contacts in the statewide GIS data more closely match those of the GAT San Antonio sheet, with two noticeable differences: (1) the GIS geology polygons combine alluvium and terrace deposits and (2) the 1:250,000-scale GAT contacts appear to have more detail in their placement than the 1:100,000-scale GIS contact lines, which look generalized (fig. 4). The 1:250,000-scale structural map of the San Antonio segment of the Edwards Aquifer (GMAP 42707) also covers the mission units of the park. Most of this map is north of the area of interest, but structural contours following the base of the Del Rio Formation are available from the Texas Bureau of Economic Geology (red-lined area in fig. 2). Andrea Croskrey received these data from Tom Tremblay (Texas Bureau of Economic Geology) is sending these data (Andrea Croskrey, Geologic Resources Division, e-mail, September 22, 2008).

Options for surficial geology coverage are the GAT San Antonio sheet (GMAP 2879) and Plate 1: Environmental Geology of *The Guadalupe-Lavaca-San Antonio-Nueces River Basins Regional Study* (GMAP 69844) (fig. 5). Eddie Collins (Texas Bureau of Economic Geology) located the 1:24,000-scale work maps that were used to compile both of these maps at scale 1:250,000; Amanda Masterson is arranging for the GRE Program to get scans of these maps.

John Gordon (U.S. Geological Survey, San Antonio) mentioned that Allan Clark was mapping karst features for the City of San Antonio and that GRE staff should inquire if any features were near the park. Andrea Croskrey contacted Allan Clark but his work is not in the area of interest for San Antonio Missions. However, he did mention that Tom Ewing, a local petroleum geologist, was looking at the source rock of the missions as a hobby. Andrea Croskrey send an e-mail to Tom Ewing but has not heard back (Andrea Croskrey, Geologic Resources Division, e-mail, September 22, 2008).

Based on the information available as of June 2008, GRE staff will digitize the San Antonio West, San Antonio East, Terrell Wells, Southton, Elmendorf, Losoya, and Saspamco USGS 7.5-minute quadrangles of the *Ground-Water Geology of Bexar County, Texas*, for bedrock geology and faults. GRE staff will digitize the bedrock geology for Floresville, Dewees, and the remaining parts of the Elmendorf, Losoya and Saspamco USGS 7.5-minute quadrangles from *Ground-Water Geology of Wilson County, Texas*. GRE staff will pull the surficial geology from the GAT San Antonio sheet, particularly as Eddie Collins was able to find the 1:24,000-scale worksheets. Another option for providing environmental geology comes from San Antonio East and Llano East sheets in *The Guadalupe-Lavaca-San Antonio-Nueces River Basins Regional Study*.

Summary of Mapping Plan

- Digitize 1:125,000-scale, county bedrock maps (Quadrangles: San Antonio West, San Antonio East, Terrell Wells, Southton, Elmendorf, Losoya, Saspamco, Floresville, and Dewees).
- Digitize 1:24,000-scale surficial geology from GAT work maps (Quadrangles: San Antonio West, San Antonio East, Terrell Wells, Southton, Elmendorf, Losoya, Saspamco, Floresville, and Dewees).
- Convert 1:250,000-scale structural geology from *Structure Map of the San Antonio Segment of the Edwards Aquifer and Balcones Fault Zone, South-Central Texas* (Quadrangles: San Antonio West, San Antonio East, and Terrell Wells; parts of Southton, Elendorf, and Losoya).

Table 1. Published Geologic Maps in the Vicinity of San Antonio Missions National Historical Park

GMAP[1]	Citation	Format	Notes
72509	Texas Commission on Environmental Quality. 2004. *Geologic atlas of Texas*. Scale 1:250,000. Austin, TX: Texas Commission on Environmental Quality.	Clipped, scanned, and georeferenced TIFs	Not going to use
74114	Stoeser, D. B., G. N. Green, L. C. Morath, W. D. Heran, A. B. Wilson, D. W. Moore, and B. S. Van Gosen. 2005. *Preliminary integrated geologic map databases for the United States: Central states—Montana, Wyoming, Colorado, New Mexico, Kansas, Oklahoma, Texas, Missouri, Arkansas, and Louisiana*. Scale 1:100,000. Open-File Report OF-2005-1351. Reston, VA: U.S. Geological Survey.	Shapefiles	Not going to use
27997	Arnow, T. 1963. Geologic map of Bexar County. Scale 1:125,000. In *Ground-Water Geology of Bexar County, Texas*. Plate 1. Water-Supply Paper 1588. Reston, VA: U.S. Geological Survey.	Paper	Bedrock; no Quaternary alluvium (Qal); digitize for faults and bedrock geology
2879	Barnes, V. E. 1974. San Antonio sheet. Scale 1:250,000. In *Geologic Atlas of Texas*. Austin, TX: University of Texas, Bureau of Economic Geology.	Paper	Digitize 1:24,000-scale working maps; Texas Bureau of Economic Geology will send scans of the original sheets of Quaternary deposits; use for surficial geology coverage
69844	Wermund, E. G., T. C. Gustavson, L. E. Garner, R. A. Morton, C. M. Woodruff, G. Macpherson, L. McKinney, J. Nilsson, C. T. Waddell, J. Basciano, and S. Holden. 1985. Environmental geology. Plate 1. San Antonio East and Llano East sheets. Scale 1:250,000. In *The Guadalupe-Lavaca-San Antonio-Nueces River Basins Regional Study*. Austin, TX: University of Texas, Bureau of Economic Geology.	Paper	GRE should be receiving 1:24,000-scale scans of the originals; use as environmental geology layer
42707	Collins, E. W., and S. D. Hovorka. 1997. *Structure map of the San Antonio segment of the Edwards Aquifer and Balcones fault zone, south-central Texas. Structural framework of a major limestone aquifer: Kinney, Uvalde, Medina, Bexar, Comal, and Hays counties*. Scale 1:250,000. Miscellaneous Map MM-38. Austin, TX: University of Texas, Bureau of Economic Geology.	Paper	Structure contours, geologic observation points, and faults
69327	Sellards, E. H. 1919. *The geology and mineral resources of Bexar County*. Scale 1:189,000. Bulletin 1932. Austin, TX: University of Texas.	Paper	Historical quarries?
	Karst features	?	From Allan Clark (USGS–San Antonio); not in park's area of interest
74964	Anders, R. B. 1957. *Ground-water geology of Wilson County, Texas*. Bulletin 5710. Austin, TX: Texas Board of Water Engineers.		Use for bedrock

[1]GMAP numbers are unique identification codes used in the GRE database.

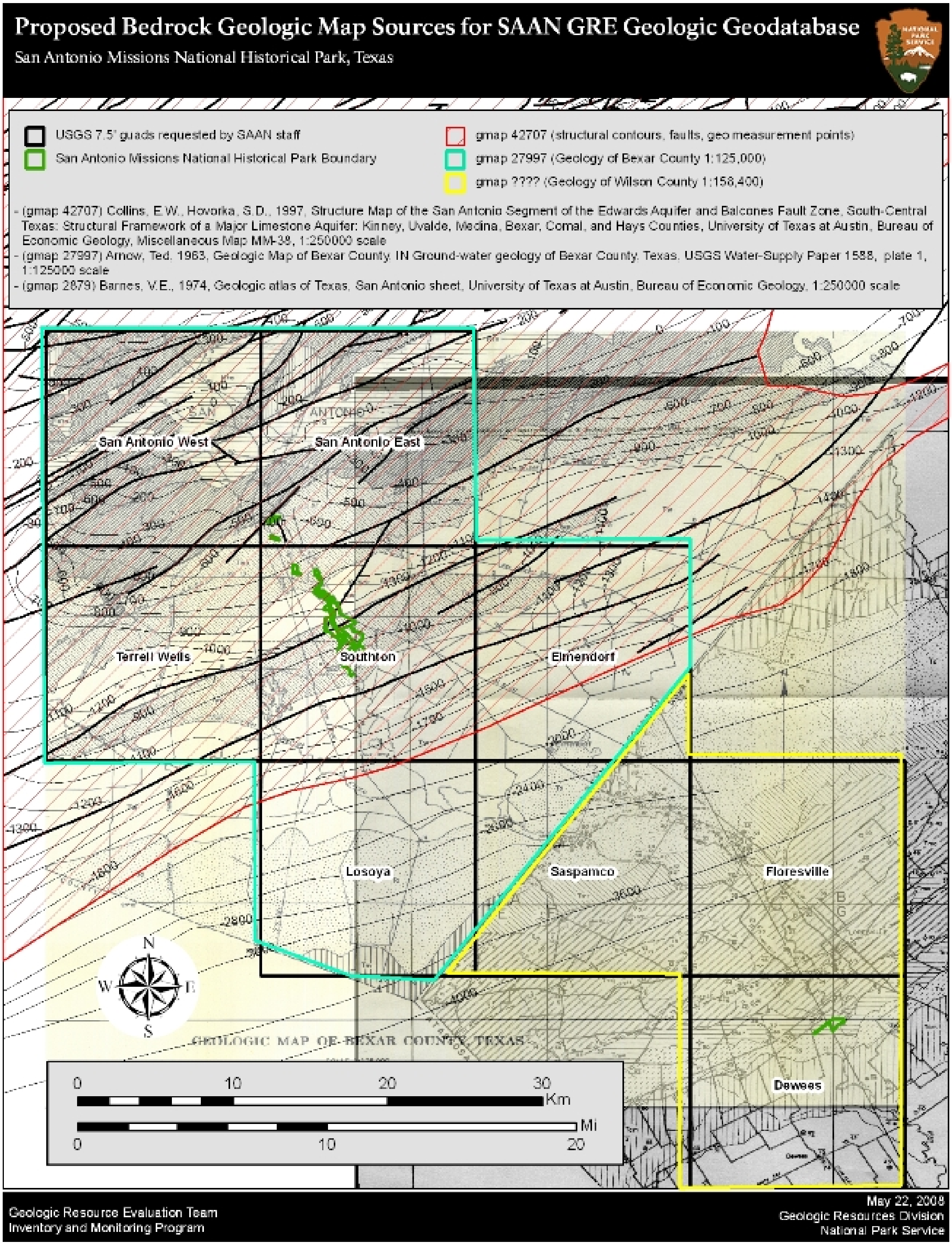

Figure 2. Area of Interest for San Antonio Missions National Historical Park. San Antonio Missions National Historical Park has nine quadrangles of interest, which are labeled and outlined in black. The figure shows proposed bedrock map sources.

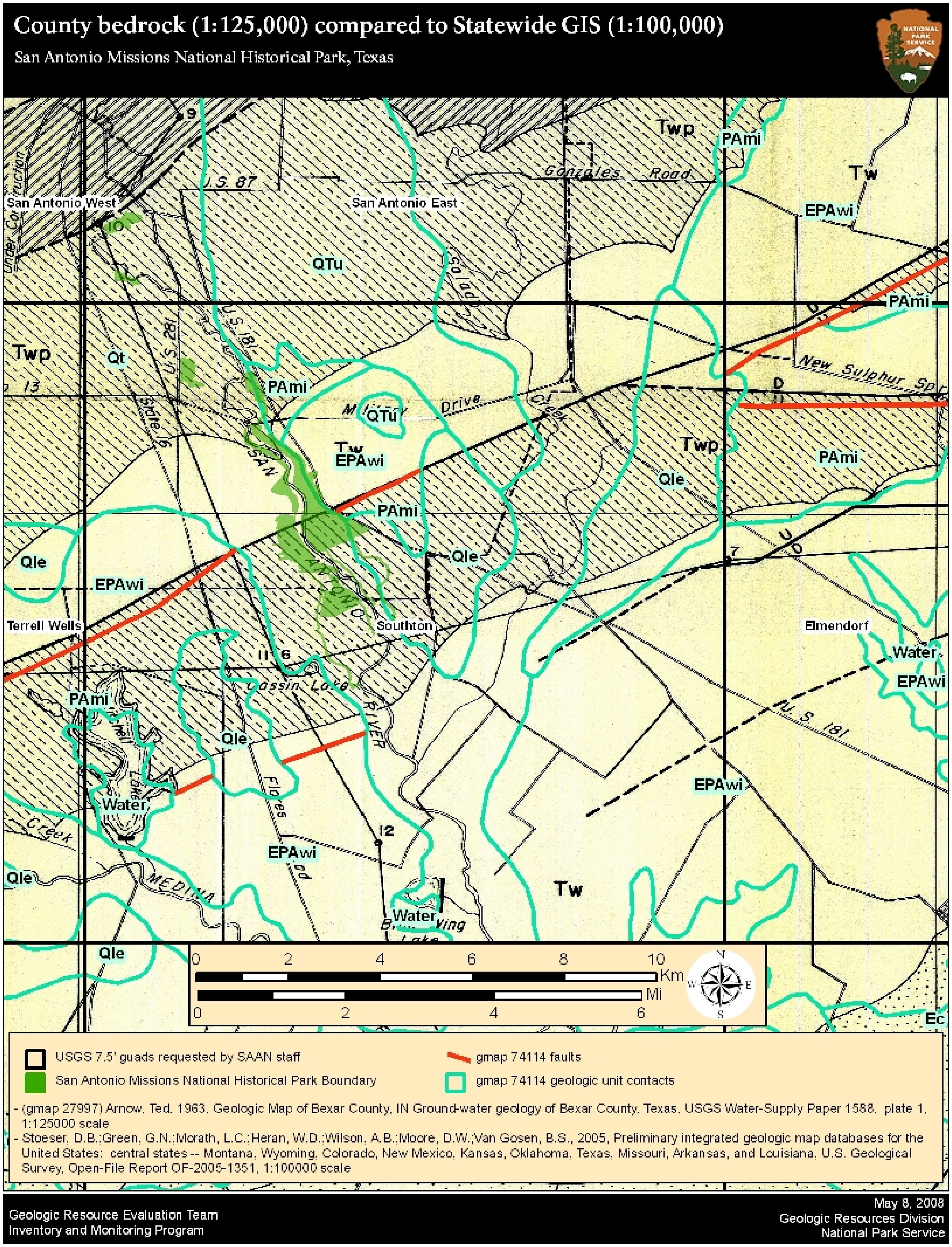

Figure 3. Comparison of County and Statewide GIS Geology for Area of Interest. The figure shows GIS geology available for Texas over the Bexar County map. Note discrepancies in faults and the absence of surficial units on the county map.

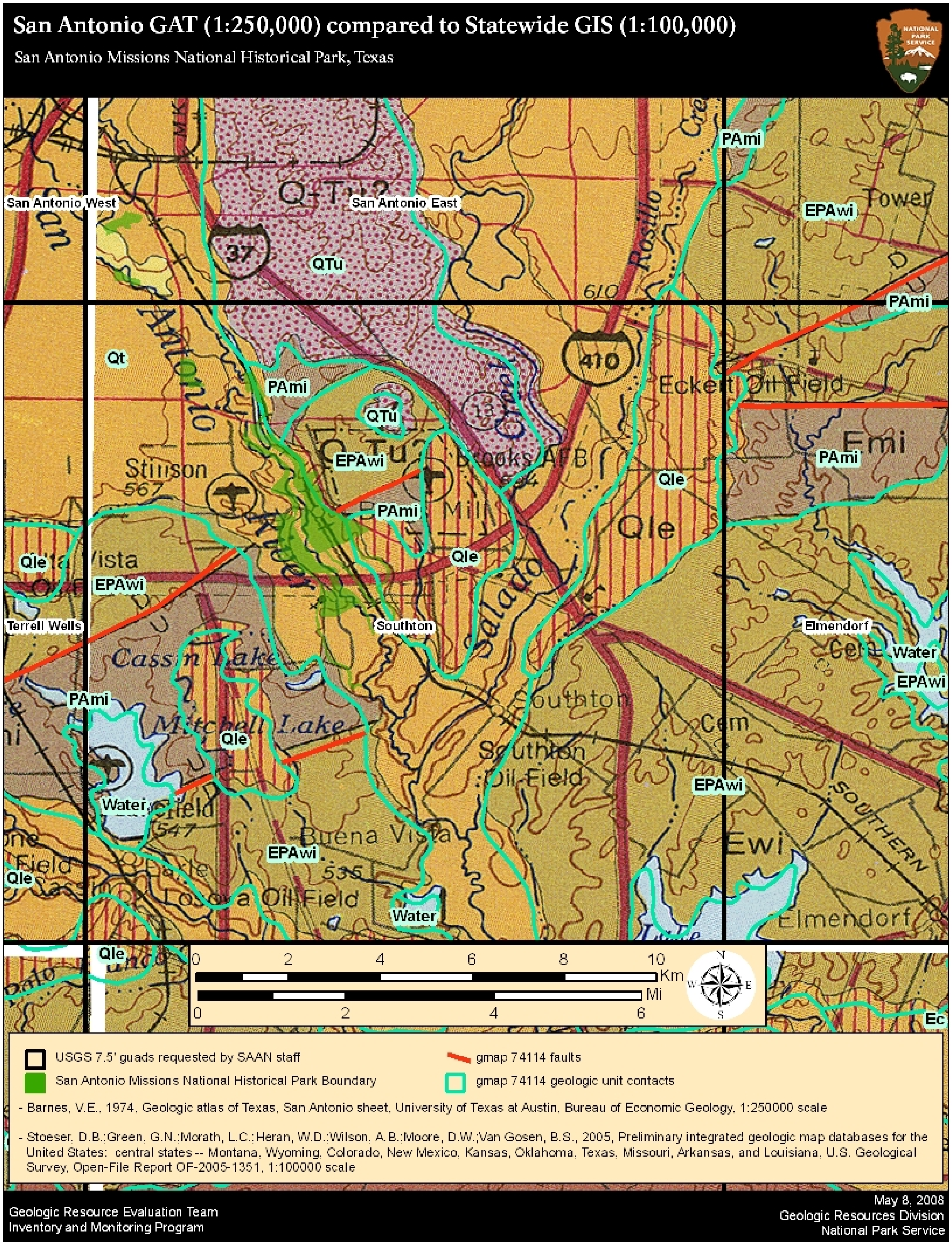

Figure 4. Comparison of Statewide GIS Geology and *Geologic Atlas of Texas* for Area of Interest. Figure shows the GAT San Antonio sheet. Note the difference in the contact line work and the absence of a few surficial units in the GIS data.

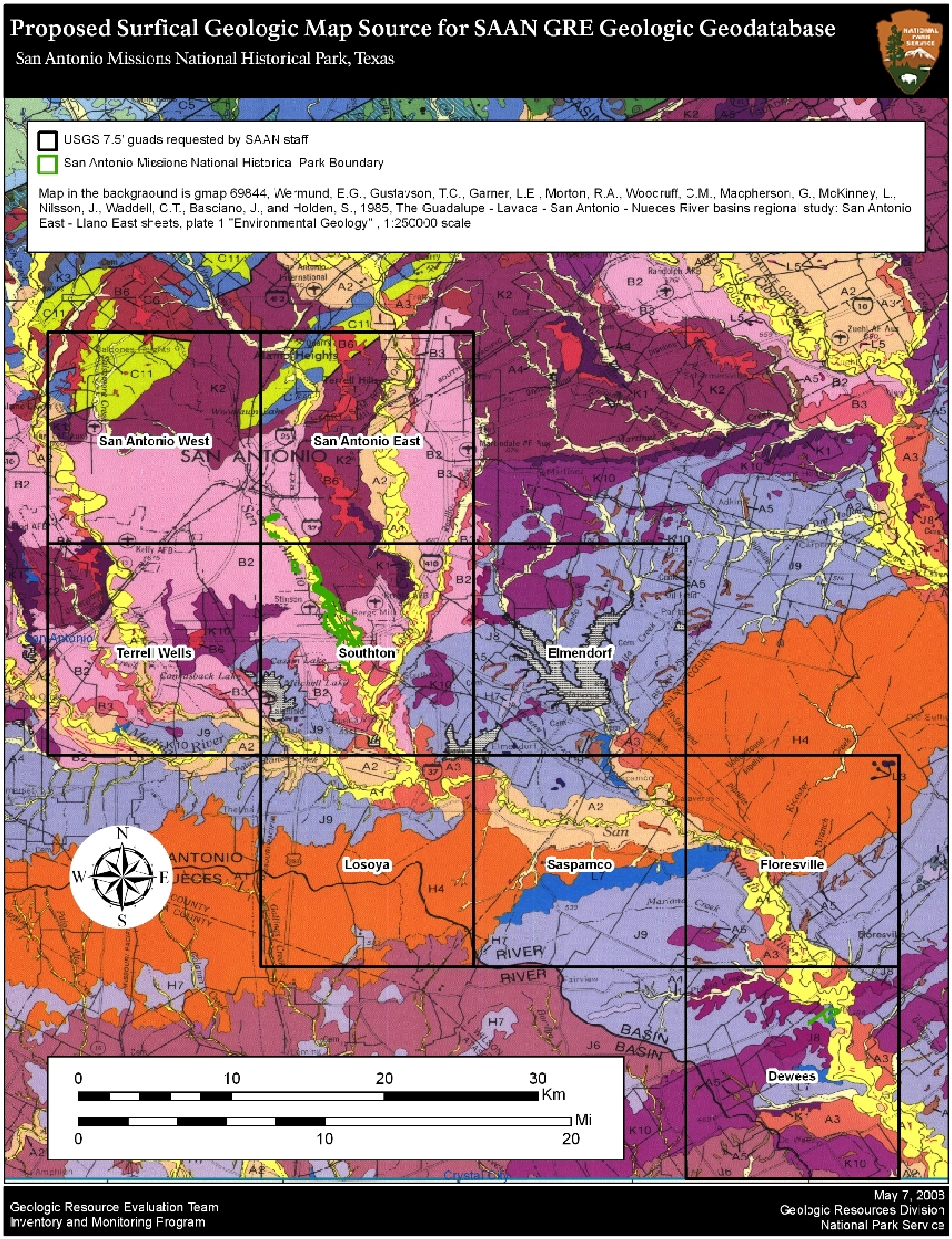

Figure 5. Proposed Surficial Maps for Area of Interest. The figure shows the proposed environmental geology source map.

Geologic Features and Processes and Related Management Issues

The scoping session for San Antonio Missions National Historical Park provided the opportunity to discuss management-related geologic issues and develop a list of geologic features and processes, which will be further explained in the final GRE report. During scoping, participants did not prioritize the issues, but discussion made it clear that cultural-geologic resource connections, fluvial features and processes, and karst have high management significance. These are discussed first, followed alphabetically by other features and processes at the park.

Cultural-Geologic Resource Connections

A primary connection between the cultural and geologic resources is the historic quarries (source areas) and building stone. During scoping, participants mentioned a limestone quarry at Rancho de las Cabras. In addition, scoping participants visited a tufa quarry at Mission Concepción. Part of this quarry may now be Concepción Park (Ewing 1996). The tufa may have been deposited from a former spring rising from the aquifer along a fault zone; the mission is located very close to the downdip limit of freshwater in the Edwards Aquifer (Mission Pump Station wells are immediately to the north) (Ewing 1996). The stone for the tufa walls of Mission Concepción was apparently quarried from this site (Ewing 1996).

Ewing (1996) also discusses building stone at Mission San José: "sandy limestone" (Wilcox Formation), Concepción tufa, Austin limestone, and an armor of coarse pebbly (pisolitic?) plaster or mortar. McGannon (1975) discusses the freshwater oolites found in some building stone. The rose window and door frame at Mission San José were sculpted from fossiliferous Austin Limestone (Late Cretaceous), containing marine invertebrates (e.g., oysters) (Ewing 1996). Wilcox sandstone, tufa, and calcite-cemented (pisolitic) conglomerates were used at Mission San Juan and Mission Espada. The sandstone at Missions San Juan has some good small-scale cross bedding. The bricks at Mission Espada are made of local Midway claystone (Ewing 1996).

In addition to building stone, the location of former channels of the San Antonio River is of management significance; these channels and associated terraces could host significant cultural information and artifacts.

Fluvial Processes and Runoff

Dredging, filling, bank stabilization, damming, and flood control developments has modified and channelized the majority of the San Antonio River in the vicinity of the park. This makes characterization of the former channel pattern difficult (Osburn et al. 2007). Picosa Creek that runs through Rancho de las Cabras is "natural" and not channelized; a portion of the acreage is in the floodplain. The creek floods and creates an arroyo system at the ranch property.

The park brochure warns of flash floods, which are "common and deadly." During flooding, the Piedras Creek threatens the aqueduct. When the San Antonio River rises, the mission trail south of Mission San José is closed. Water in the historic river channel near Mission San Juan rises and falls, flooding and depositing sediment in the nature trail area.

With respect to preserving structures at the park, water is a constant problem. Limestone buildings absorb water, which leads to instability. Runoff of modern impervious surfaces causes concern for historic buildings. Park staff has cut swales to channel water away from buildings in some areas. Sheetwash produces a buildup of sediment in *acequias* at Mission San José, which park staff periodically clears. Some of these sediments could be contaminated.

Karst

San Antonio sits on the Edwards Aquifer—a famous groundwater source and reservoir in karstic limestone. The Edwards Aquifer is prone to dissolution. Legends abound of tunnels running under the city, which like all good legends has a basis in fact. During scoping, participants toured Mission Concepción, where park staff pointed out an area where a sinkhole recently appeared. Ironically, this mission was built on bedrock, unlike the others which were built on clay. Under these geologic conditions, however, building on rock was not a "solid" idea. The other missions (on clay) are not experiencing subsidence. Park managers combined resource management, maintenance, and interpretation in restoring the sinkhole site at Mission Concepción. A new drainage system diverts water away from the mission into a swale and also serves as an interpretive "exhibit" (fig. 6).

Figure 6. Sinkhole Area at Mission Concepción. The National Park Service has mitigated a sinkhole hazard at the corner of the mission by filling the sinkhole with cement and diverting water away from the building. The project also has interpretive value: the red cement indicates past interior spaces (of the granary) and the white cement and cobble represent walls.

Presently, geologists from the U.S. Geological Survey (Allan Clark) are mapping karst features for the City of San Antonio. However, Clark's study area does not extend to parklands. He is interested, however, in doing a geophysics study of karstic features at San Antonio Missions National Historic Park. In an e-mail (May 9, 2008) to Andrea Croskrey, Allan Clark wrote:

> As far as karst in the Mission Concepcion area, I have not heard of any but it would not surprise me that collapse can happen down there. Many of the springs in the area issue from the Austin Chalk which is definitely a karstic formation. I have also seen spring issuing from the formations above the Austin Chalk especially during times of high water levels so it would stand to reason that subsequent collapse could occur. It might be worth contacting Tom Ewing (a local petroleum geologist) [who] has made it a hobby of specifically looking at the missions and associated geology, especially where they obtained their building materials etc. Tom's contact info is as follows: tewing@fronteraexploration.com, 210-493-1626.

Ewing is the author of a guidebook that highlights the rocks used in constructing the missions (see Ewing 1996). In addition, Clark recommended that park managers consider a study conducted at Salinas Pueblo Missions National Monument in New Mexico (see Ball et al. 2006), which may provide insight and ideas for interpreting and mitigating karstic features at Mission Concepción.

Climate Change

Losing Ground: Western National Parks Endangered by Climate Disruption states, "A climate disrupted by human activities poses such sweeping threats to the scenery, natural and cultural resources, and wildlife of the West's national parks that it dwarfs all previous risks to these American treasures" (Saunders et al. 2006). The authors contend that "a disrupted climate is the single greatest threat to ever face western national parks." Because of the potential disruption that climate change could cause to park resources, including geologic features and processes, the GRE Program has begun to include a discussion of the effects of climate change to park resources as part of scoping meetings. During scoping at San Antonio Missions National Historical Park, participants mentioned range expansion (moved north) of the Eurasian collared dove *(Streptopelia decaocto)* as anecdotal evidence of climate disruption. Changes in climate that could affect geologic processes include shorter but more intense monsoons and longer droughts.

Disturbed Lands

Modern human activities have disturbed more than 315,000 acres (127,480 ha) in 195 National Park System units. Most are not in keeping with the mandates of the National Park Service, but some of these features may be of historical significance. For instance, the National Park Service is purchasing old homesteads and farms and restoring them to Spanish colonial–era fields called *labores*. Another disturbance of natural processes that has cultural significance is the *acequia* system. Also building stone may have been minded during Spanish colonial times at a quarry at Rancho de las Cabras; however, 20th-century mining has since occurred in the same place, obscuring historical evidence.

Most disturbances that require restoration at San Antonio Missions occur at Rancho de las Cabras. For instance, overgrazing has resulted in erosion and invasion of exotic mesquite. When floods wash out a fence that was built to prevent trespass, cattle wander onto parklands, causing erosion of river banks. In addition, feral pigs impact soils. In the 1950s soils from a channelization project were dumped onto park lands. Disturbances outside the park that could affect park resources include storm-water erosion, urban development, invasions of exotic plants, uranium mining proposed for Goliad County, and a jet-fuel refinery.

Geothermal Features and Processes

During the early 1900s ("Silent Movie Era"), a commercial hot springs—"Hot Wells"—on the boundary of the park was a popular recreational destination. The site has since fallen into ruins, though the present owner has "grand plans" for its development. Scoping participants were not aware of any hot springs within the park.

Hillslope Features and Processes

The cycle of precipitation at San Antonio Missions National Historical Park is torrential rains—25 cm (10 in) per day—punctuating periods of drought. This and the construction that accompanies urbanization concentrate runoff and exacerbate sloughing of material along river terraces. Slumping occurs in the *acequias* and near the lime kiln at Mission Espada. Slopes are unstable along Piedras Creek near the aqueduct. Where the nature trail at Mission San Juan runs along cut banks, it is in danger of slumping off.

Oil and Gas Exploration and Development

The nearest oil and gas activity is in Floresville, Texas, which produces from Lower Cretaceous units. Scoping participants believe that oil and gas was produced from the Austin Chalk in the 1980s at Rancho de las Cabras. If needed, Eddie Collins (Texas Bureau of Economic Geology) could check on the existence of old wells, as could GRD staff (e.g., Pat O'Dell, Lisa Norby, or Keri Moss). Park staff is unaware of any proposed development.

Paleontological Resources

In 2007 the National Park Service completed a baseline inventory of paleontological resources at San Antonio Missions National Historical Park (see Kenworthy et al. 2007). Although rock exposures are limited within the park, all the geologic formations, including terrace gravels, in the vicinity yield paleontological resources, so potential exists within the park. Of immediate interest may be fossiliferous units exposed as a result of the Army Corps of Engineers restoration project along the San Antonio River. According to Kenworthy et al. (2007), potential paleontological resources include the following (from youngest to oldest):

- Terrace gravels (Pliocene, Pleistocene, and Holocene): mammoth teeth and bones
- Wilcox Group (Eocene): marine invertebrates (e.g., clams) and plants (e.g., leaf impressions)
- Midway Group (Paleocene): shark teeth, molds of bivalve shells, and fossil plant material
- Navarro Group (Late Cretaceous): marine invertebrates (e.g., oysters)

Seismic Features and Processes

San Antonio Missions National Historical Park is seismically quiet, although a 4.0 magnitude (on the Richter scale) earthquake was felt in 2008. The epicenter was southeast of San Antonio. Park managers are interested but not overly concerned about seismic impacts to structures at the park.

Research Needs

Scoping participants identified three research needs at San Antonio Missions National Historical Park:

1. Conduct detailed mapping of karst features at Mission Concepción, which is important for the preservation of historic structures.
2. Conduct detailed geomorphic mapping to identify historically significant quarries and former channel locations of the San Antonio River.
3. Complete a thorough inventory of the park’s paleontological resources.

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Table 1. Scoping Meeting Participants for San Antonio Missions National Historical Park

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John Gordon	U.S. Geological Survey (San Antonio)	Hydrogeologist	210-691-9235	jgordon@usgs.gov
Bruce Heise	Geologic Resources Division	Geologist/GRE Program Coordinator	303-969-2017	bruce_heise@nps.gov
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